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CONDITIONED PUNISHMENT[1]

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Responses of pigeons were maintained by a VI schedule of food reinforcement. Conditioned punishment was programmed by having these responses concurrently produce an originally neutral stimulus. The effectiveness of this response-contingent stimulus was maintained by infrequent and prearranged stimulus-shock pairings delivered independently of responses. This conditioned punishment procedure reduced the overall response rate as long as the procedure was in effect. The extent and durability of the reduction was a function of the intensity of the shock that was paired with the stimulus. Analysis of the reduction in the overall response rate revealed: (1) a reduction of responses occurring in the absence of the response-contingent stimulus, which was designated as a "punishing" effect, and (2) a reduction of responses during the response-contingent stimulus, which was designated as a "suppressive" effect.

When the onset of a stimulus immediately follows a response, and the future probability of that response is thereby reduced, the stimulus may be designated as a punisher and the entire process may be defined as punishment (Azrin and Holz, in press). This definition of punishment differs from previous procedural definitions (Ferster and Skinner, 1957; Holland and Skinner, 1961) in that it includes a specific behavioral effect in addition to a procedure. Procedurally, the definition requires that a stimulus be contingent upon a specific response and that the stimulus follow immediately after that response. Behaviorally, the definition requires that the future probability of a response must be reduced when the response may be followed by the stimulus onset. A reduction in the presence of the stimulus does not qualify. Recent investigations have consistently demonstrated this punishment effect, *i.e.*, Azrin (1960), Azrin, Holz, and Hake (1963), Appel (1961), Holz, Azrin, and Ulrich (1963), Dardano and Sauerbrunn (1964). The present definition of punishment is analogous to the usual definition of positive reinforcement (Holland and Skinner, 1961), the principal difference being the direction of behavioral change.

Following the convention for positive reinforcement, a stimulus which functions as a punisher without a history of conditioning may be designated an unconditioned punisher. This analogue between positive reinforcement and punishment further suggests that an originally neutral stimulus might become a punisher as a result of pairings with an unconditioned punisher. Such a stimulus will be designated as a conditioned punisher. Defined as a process, conditioned punishment results when it can be shown (1) there is little or no punishment effect before the stimulus is paired with an unconditioned punisher, but (2) a punishment effect occurs after (3) the stimulus has been paired, or is being paired, with an unconditioned punisher.

The existence of conditioned punishment has been suggested by several experiments (Baron, 1959; Evans, 1962; Mowrer and Aiken, 1954; Mowrer and Solomon, 1954). In these experiments a stimulus was paired with electric shock in a "training" chamber. Then, the shock was discontinued and the stimulus was made contingent upon a selected response in

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a "test" chamber. The use of a separate chamber for the stimulus-shock pairings eliminated the possibility of a response-shock correlation and reduced the inductive effects of the shock. Most of these experiments found a response reduction that was attributable to conditioned punishment. In those studies in which a conditioned punishment procedure has been effective, exposure to that procedure has been limited to 15 to 30 min. Exposure was necessarily limited since the stimulus could be expected to lose its effectiveness when the pairings with shock were discontinued. In the present experiment, the stimulus-shock pairings were continued in order to give the stimulus a more enduring effectiveness and thereby allow conditioned punishment to be studied more intensively.

One method of maintaining the effectiveness of a conditioned punisher would be to alternate "training" sessions, during which the stimulus-shock pairings were given, with "testing" sessions during which the stimulus alone was given. This alternating procedure would be consistent with the design of the previous experiments which employed conditioned punishment. However, such a procedure appears unsatisfactory. It would allow both temporal and situational bases for a discrimination that shocks would occur while in the training situation but never in the test situation. To avoid these potential sources of discrimination, stimulus-shock pairings were provided at irregular intervals in the test situation. The "testing" of conditioned punishment was possible during the long intervals between stimulus-shock pairings. The procedure for pairing a stimulus and a shock at prearranged times while an animal is responding for food reinforcement is identical to the conditioned suppression procedure of Estes and Skinner (1941). The present experiment arranged conditioned punishment during the time intervals between the prearranged stimulus-shock pairings of a conditioned suppression procedure.

EXPERIMENT I: "ADDITIVE" CONDITIONED PUNISHMENT PROCEDURE

Subjects and Apparatus

Four adult White Carneaux pigeons were maintained at 85% of free feeding body weight. The experimental space, measuring 14 by 14 by 16 in., was inside a sound-attenuating and light-proof box. A translucent response key was in the center of one wall. A key peck of 15 g defined a response. Reinforcement was a 3-sec access to a grain mixture.

The stimulus paired with shock was a clicking tone combined with a simultaneous change in the color of the response key. The electric shock was a brief (100 msec) 60 cycle ac shock delivered through a 10K series resistor to electrodes implanted in the tail region of the subject (Azrin, 1959).

Procedure

Phase I: Stimulus-Shock Pairing. The sequence of the procedures in all phases of the experiment is shown for each subject in Table 1. First, to provide a stable baseline of responding, a minimum of 30 hr exposure to a 2-min VI reinforcement schedule was provided. Each daily session lasted 2 hr. Then, to provide a control for the inherent effects that the response-contingent stimulus might have before pairing it with shock, the conditioned punishment procedure was run for at least three sessions without shock. In conditioned punishment, a response in the absence of the stimulus produced the stimulus for 5 sec; a response during the response-contingent stimulus extended it 5 sec from the time of the response. Since responses in the presence of the response-contingent stimulus extended its duration, this procedure has been designated as "additive" conditioned punishment to differentiate it from the "non-additive" procedure of Exp II. The prearranged stimulus presentations (later paired with shock) occurred at irregular intervals averaging 6 min apart (4 min for subject 605). Each prearranged stimulus presentation always lasted for 15 sec; responses during the prearranged stimulus did not extend it. To minimize interaction between the two components on the basis of reinforcement, one 2-min VI tape was used during the response-contingent and prearranged presentations of the stimulus and an identical tape was used when the stimulus was absent.

Next, the response-contingent stimulus was discontinued and the conditioned suppression procedure introduced in order to pair the stimulus with shock before testing the punishing effects of the stimulus. The prearranged

Table 1
Sequence of Experimental Procedures in Experiment I

	Shock Intensity (volts)	Subjects			
		110	86	515	605
Phase I	0	2′ VI CP CS	2′ VI CP CS	2′ VI CP CS	2′ VI CP CS
	20		CS	CS	
	40	CS	CS	CS	
	50				CS CP
	60	CS	CS	CS	
	80	CS	CS	CS	
	90	CS	CS		
	100	CS CS-CP CP	CS CS-CP CP	CS CP	CS CP
	150	CP CS	CP CS	CP CS	CP CS
	200	CS CS-CP CP	CS CP	CS CP	CS CP
Phase III	240		CP CS		
	280		CS CP		
	360		CP CS		
	400		CS CP		CP CS

Key: 2′ VI = Baseline: 2 min variable interval schedule of reinforcement.
CP = Conditioned Punishment.
CS = Conditioned Suppression.
CS-CP = Phase II. Introduction of conditioned punishment following conditioned suppression. Shock discontinued during conditioned punishment.

presentations of the stimulus were continued at the same irregular intervals as above with the separate 2-min VI reinforcement tapes in the presence and absence of the prearranged stimulus. The shock was not introduced for at least three sessions to provide a control for the inherent effects of the stimulus during conditioned suppression. Then, the shock was presented at the end of the prearranged stimulus. The shock intensity was increased gradually up to 100 v (50 v for S-605) with at least one session at each shock intensity.

Phase II: Conditioned Punishment with Stimulus-Shock Pairing Discontinued. Phase II attempted to replicate the previous findings on conditioned punishment. The shock was discontinued when conditioned punishment was introduced. Two of the four subjects were used in Phase II, which lasted one session. Conditioned suppression was in effect for the first 30 min at a shock intensity of 100 v. Then, conditioned punishment was introduced: a response produced the stimulus for 5 sec. On introducing conditioned punishment, the shocks were discontinued, although the prearranged presentations of the stimulus continued. Subject 110 was later run in a second session in which the shock intensity was 200 v for the first 30 min.

Phase III: Conditioned Punishment with Continued Stimulus-Shock Pairing. In Phase III, the effects of conditioned punishment

with continued stimulus-shock pairings were assessed at several shock intensities. All four subjects were used. As in the additive conditioned punishment procedure of Phases I and II, a response in the absence of the stimulus produced the stimulus for 5 sec; a response during the response-contingent stimulus extended it for 5 sec from the time of the response. The prearranged stimulus-shock pairings continued at the same irregular intervals (6-min VI or 4-min VI) as in the conditioned suppression procedure. To prevent a discrimination that the stimulus was never paired with shock when produced by a response, the prearranged stimulus-shock presentations were allowed to begin during the response-contingent stimulus. When this adventitious overlap did occur, the shock still occurred 15 sec after the onset of the prearranged stimulus, thereby providing an apparent association of the shock and the response-contingent stimulus.

As a control for the effects of the prearranged stimulus-shock presentations *per se*, *i.e.*, inductive effects of the shock or an unconditioned punishment effect resulting from an adventitious response-shock correlation (Azrin, 1956), the conditioned suppression procedure was also run alone in separate sessions. It is referred to as the "shock control" in Phase III. The frequency of the prearranged stimulus-shock presentations was the same for both shock control (conditioned suppression) and conditioned punishment procedures. The only difference between them was the response-contingent stimulus of the conditioned punishment procedure.

During Phase III, shock intensity was increased gradually to 200 or 400 v. Both the conditioned punishment and the shock control procedures were run at a given shock intensity before moving to the next higher intensity. To eliminate some switching back and forth between the procedures, the last procedure run at a given shock intensity was usually the first run at the next higher intensity. At a given shock intensity, a minimum of five sessions was provided under conditioned punishment as well as shock control; only three sessions were provided if there was less than 15% change in overall responses and no systematic changes. To minimize the residual effects of a previous procedure, the last three sessions on each procedure were used in analyzing the results at a given shock intensity.

Results and Discussion

Figure 1 shows for one subject the changes in response rate during conditioned suppression as a function of shock intensity. At the intensity of 0 v, the response rate in the presence of the stimulus (solid line) was about equal to the response rate in its absence (dotted line). For all subjects, the response rate in the presence of the stimulus was either not reduced (three subjects) or reduced (subject 515) to no less than 70% of the response

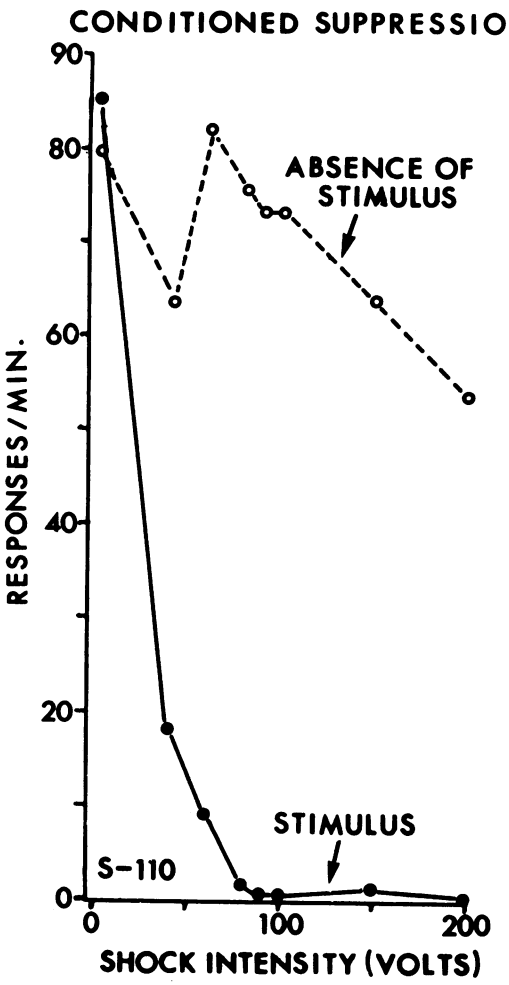

Fig. 1. The conditioned suppression procedure. Response rates in the presence of the stimulus and in its absence are presented separately as a function of shock intensity. Each point from 40-90 v represents only the last session at those intensities since only one session was usually provided at a given intensity in Phase I. The conditioned suppression procedure served as a control at the other points, which represent the mean of the last three sessions at a given intensity.

rate in the absence of the stimulus. The response rate in the presence of the stimulus decreased as a function of shock intensity. For all subjects, almost complete suppression of responding during the stimulus was obtained at an intensity between 50-100 v. The response rate in the absence of the stimulus was also reduced as a function of shock intensity, but not as much as in the presence of the stimulus. Subject 515 showed no reduction in the absence of the stimulus. The effects of the shock were largely, but not entirely, restricted to the stimulus. Annau and Kamin (1961) have reported similar findings: during conditioned suppression, the response rate in the absence of the stimulus was reduced as a function of shock intensity, but the more severe reduction occurred in the presence of the stimulus. In the present experiment, the nearly complete suppression obtained in the presence of the stimulus at an intensity between 50 and 100 v indicated that the stimulus has acquired suppressive properties through the pairing with shock before testing the punishing effects of

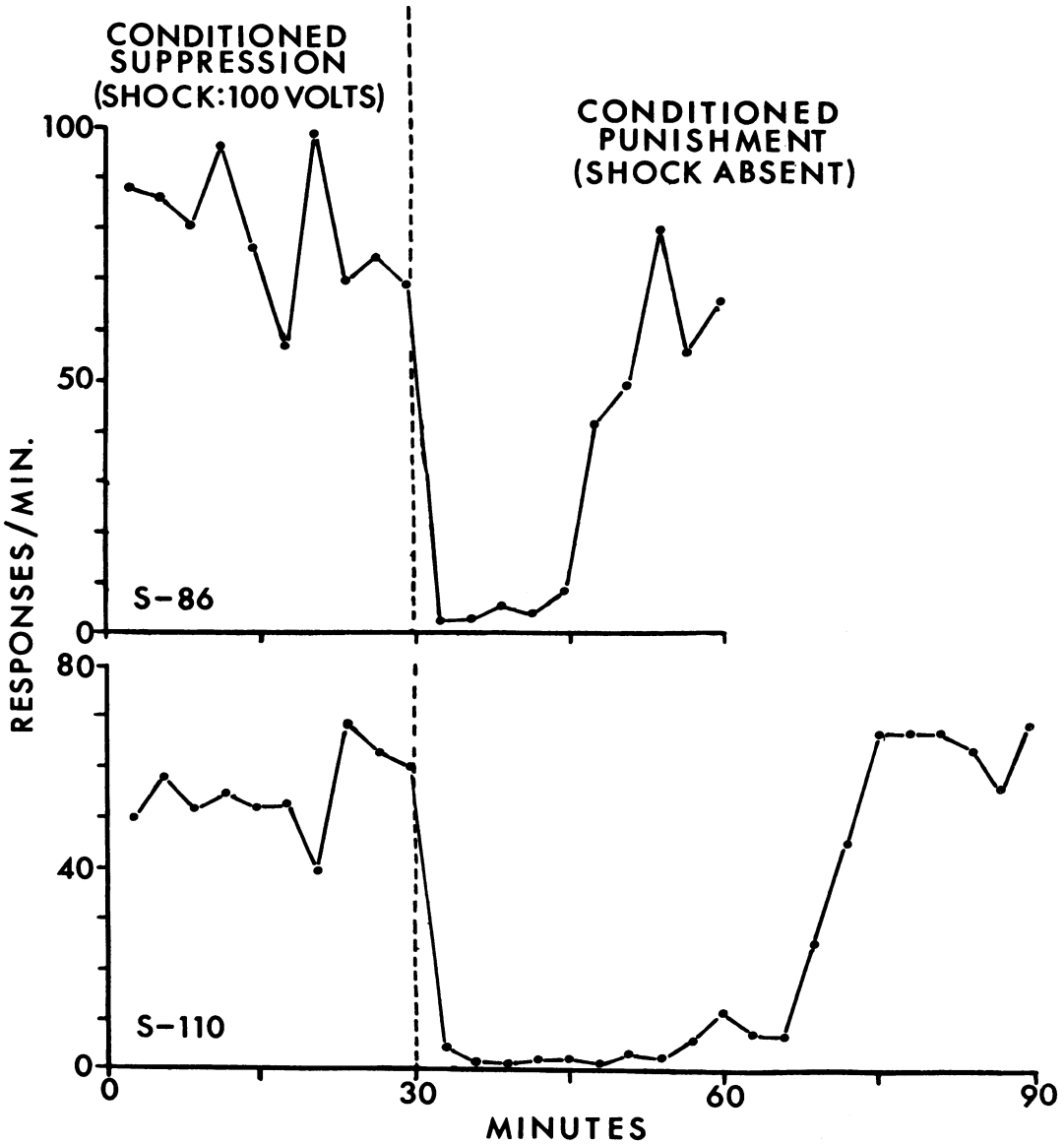

Fig. 2. The initial introduction of conditioned punishment when the shock deliveries were simultaneously discontinued. Each point represents the overall response rate for consecutive 3-min periods.

the stimulus in the conditioned punishment procedure.

Figures 2 and 3 show the effects of introducing conditioned punishment while simultaneously discontinuing the shock deliveries. The overall rate measure of Fig. 2 includes all responses both in the presence and absence of the stimulus. In Fig. 2, conditioned suppression was in effect for the first 30 min of the session with shock intensity 100 v. Then, at the dotted line, shock was discontinued and the 5-sec stimulus was made contingent upon each response. For both subjects the overall response rate was immediately reduced from about 60 or 70 responses per minute to less than six responses per minute. The response rate remained at this low level about 12 min for subject 86 and about 27 min for subject 110. Thereafter, the response rate gradually increased to approximately the pre-punishment level.

The effects of introducing conditioned punishment for the subject exposed to 200 v in the conditioned suppression procedure are shown in Fig. 3. This subject averaged about 47 responses per minute for the 30 min of conditioned suppression, the last few minutes of which are shown to the left of the dotted line. On introducing conditioned punishment (dotted line), the overall response rate immediately dropped to about three responses per minute and did not exceed seven responses per minute for about 80 min. Thereafter, the response rate gradually increased to approximately the pre-punishment level. Although the overall response rate measure of Fig. 2 and 3 does not distinguish between the rate of responses during the stimulus and in its absence, the severe reduction during the conditioned punishment procedure in Fig. 2 and 3 could not have occurred unless the stimulus did have a punishing effect, thereby reducing the rate of those responses which occurred in its absence. This punishment effect agrees with the results of previous studies employing a conditioned punishment procedure (Evans, 1962; Mowrer and Aiken, 1954; Mowrer and Solomon, 1954).

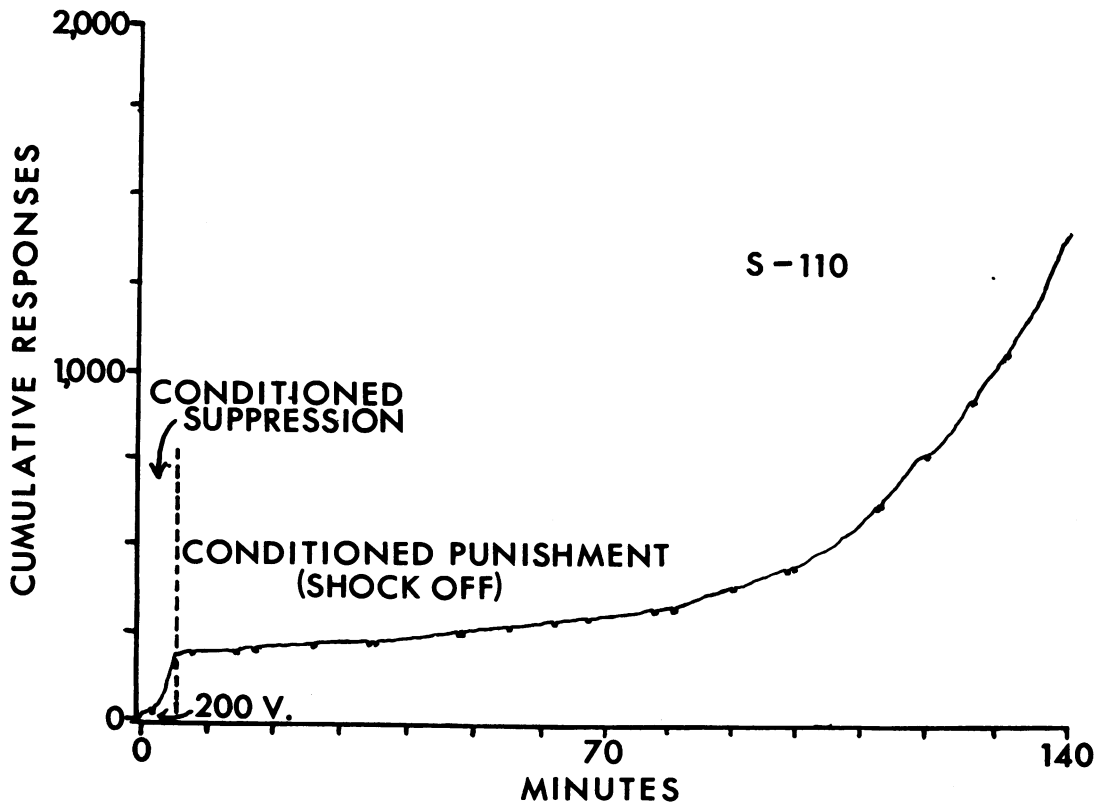

Fig. 3. The introduction of conditioned punishment when shock deliveries were simultaneously discontinued. The cumulative response record includes all responses, both in the presence and absence of the stimulus. The prearranged presentations of the stimulus are indicated by a downward displacement of the response pen.

Figures 4, 5, and 6 deal with the effect of conditioned punishment with continued stimulus-shock pairing upon the overall rate of response. The response measures in these figures include all responses in the presence and in the absence of the stimulus. Figure 4 contrasts the overall responses for the conditioned punishment and shock control (conditioned suppression) procedures as a function of shock intensity for all four subjects. The only difference between the conditioned punishment and shock control procedures was the use of a response-contingent stimulus during conditioned punishment. Before the stimulus-shock pairings (OV), the number of responses during conditioned punishment was either about the same (subjects 110 and 605) or only 12-15% less (subjects 86 and 515) than during shock

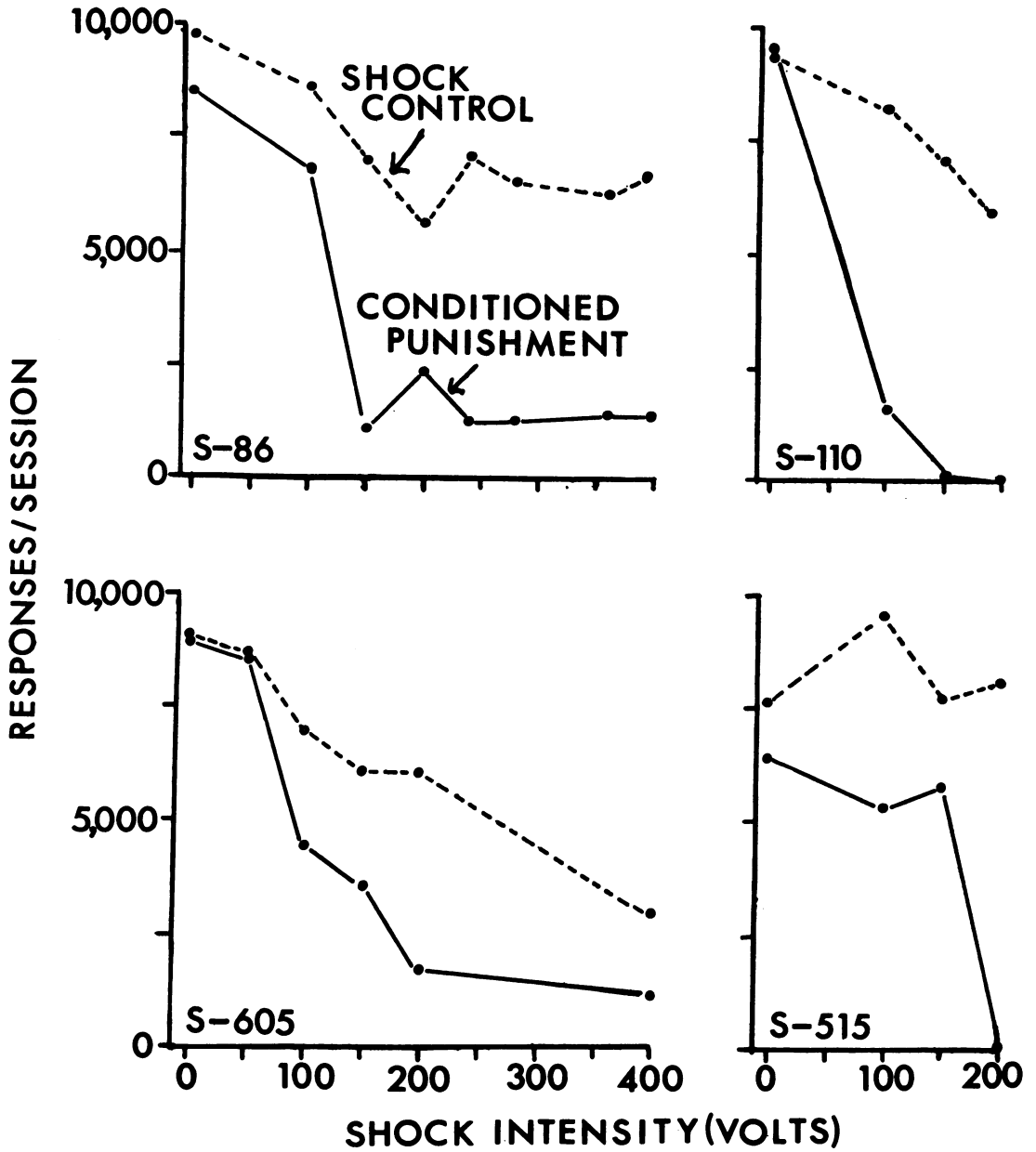

Fig. 4. Comparison of the conditioned punishment procedure with continued stimulus—shock pairings and the shock control procedure (conditioned suppression) as a function of shock intensity. Each point represents the mean number of responses per session over the last three sessions at a given intensity.

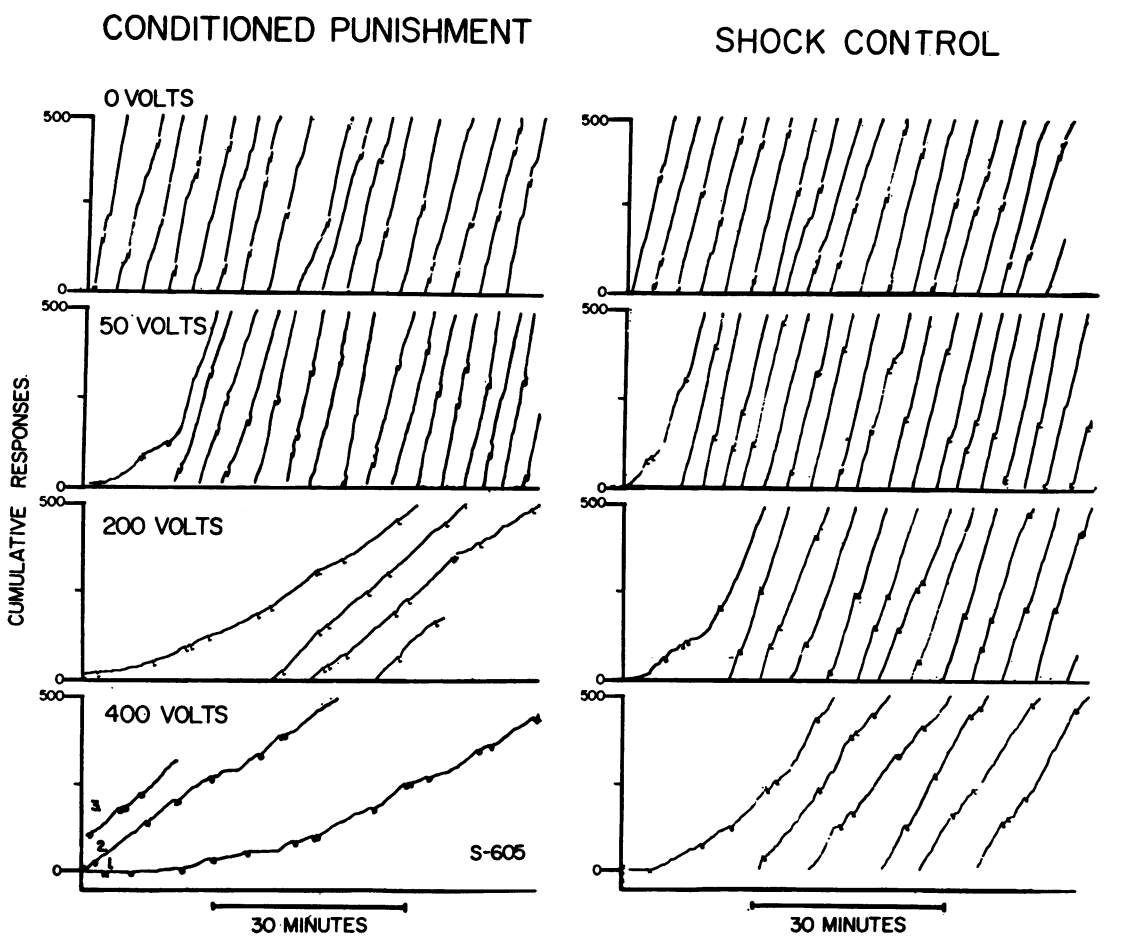

Fig. 5. The pattern of responding during conditioned punishment and shock control procedures as a function of shock intensity. Each of the "collapsed" response records represents a complete 2-hr session of final performance at a given shock intensity. For this subject, the prearranged stimulus—shock pairings occurred according to a 4-min VI and are indicated by the downward displacement of the response pen. The numbers on the segments of the 400 v conditioned punishment session indicate the order in which these segments occurred.

control. However, after the stimulus-shock pairing, the number of responses in conditioned punishment decreased as a function of shock intensity. For subjects 515 and 110 responding was almost completely eliminated (20-40 responses/session). A similar, but smaller, reduction occurred during the shock control procedure for three subjects. Responses during conditioned punishment were fewer than during shock control at all shock intensities and 60 to 99% less at the highest intensity. The results of all subjects were similar in that (1) before the stimulus-shock pairing, conditioned punishment had only a slight effect, but (2) after the pairings, the number of responses during conditioned punishment decreased as a function of shock intensity, and (3) conditioned punishment more severely reduced responses than did shock control, especially at the highest shock intensities.

The pattern of responding of one subject during the conditioned punishment and shock control (conditioned suppression) procedures is illustrated in Fig. 5. These records of complete 2-hr sessions show the overall response rate and represent final performance at different shock intensities. Before the shock was introduced (0 v), the response rate for all subjects was fairly high (between 55 and 80 responses per minute) and uniform in both procedures. This level and uniformity of response rate is characteristic of a 2-min VI schedule of reinforcement with pigeons (Ferster and Skinner, 1957). However, after the stimulus-shock pairings were introduced (50-400 v), the response rate was lower and more variable in condi-

tioned punishment (four subjects) and shock control (three subjects). A characteristic of the pattern of responding, especially during conditioned punishment, was the existence of a low response rate at the start of a session followed by recovery to a higher rate during the session. This "warm up" period has been noted in studies of unconditioned punishment (Azrin, Holz, and Hake, 1963). For all subjects and at all shock intensities, the conditioned punishment procedure produced a longer period of low response rate at the start of the session. This greater effectiveness of the conditioned punishment procedure extended throughout the session when shock intensities of 200 v or greater were used.

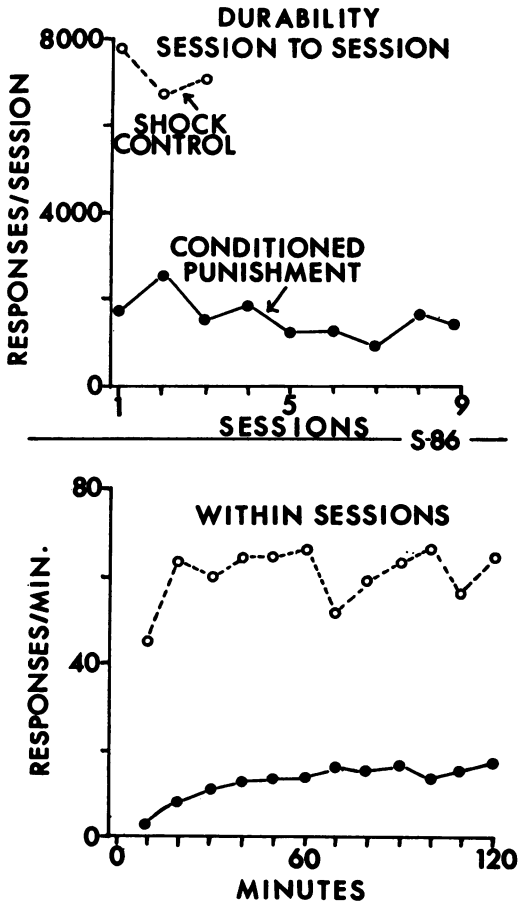

Fig. 6. The durability of the reduction in overall response rate resulting from the conditioned punishment procedure. The top half illustrates this durability over sessions. The lower half shows the durability of the response reduction within those sessions. In the lower half, each point in the conditioned punishment curve represents the mean response rate for consecutive 10-min periods averaged over the nine sessions. The 10-min periods in the shock control procedure are averaged over the last three sessions on that procedure. The shock intensity was 240 v.

Figure 6 illustrates the durability of the reduction in overall response rate resulting from conditioned punishment at shock intensities of 200 v or more. The top half illustrates this durability over sessions. The conditioned punishment curve shows the total number of responses per session for nine consecutive sessions. Terminal performance on the shock control procedure is also shown. The shock intensity during both procedures was 240 v. Comparison of the two curves reveals that conditioned punishment reduced responding below the shock control level for as long as it was in effect. The durability of this response reduction within sessions is illustrated in the lower half of Fig. 6. As was seen previously for a different subject in Fig. 5, conditioned punishment severely reduced responding at the start of the session, followed by partial recovery during it. For all subjects this recovery during conditioned punishment was incomplete at shock intensities of 200 v or greater.

The effect of conditioned punishment has been considered thus far in terms of the reduction of the overall rate of response. This is the same type of analysis used in previous studies employing a conditioned punishment procedure. In the present study, this overall effect was analyzed in terms of two sources of reduction: (1) a reduction during the response-contingent stimulus, which will be designated as a "suppressive" effect and (2) a reduction in the absence of that stimulus, which will be designated as a "punishing" effect. The solid curve of Fig. 7, top, shows that the suppressive effect was a function of shock intensity for the single subject shown. The response rates of the other subjects were similarly reduced from the initial level of 55 to 80 per min at 0 v to 0 to 10 per min at the higher shock intensities. These results show that reduction of the overall response rate by conditioned punishment was partly attributable to a response reduction during the response-contingent stimulus.

Although this suppressive effect of the response-contingent stimulus was marked, especially at the highest shock intensities, it was less severe than that observed at the same shock intensities during the prearranged stimulus of the conditioned suppression procedure (dotted curve, Fig. 7). One possible reason is

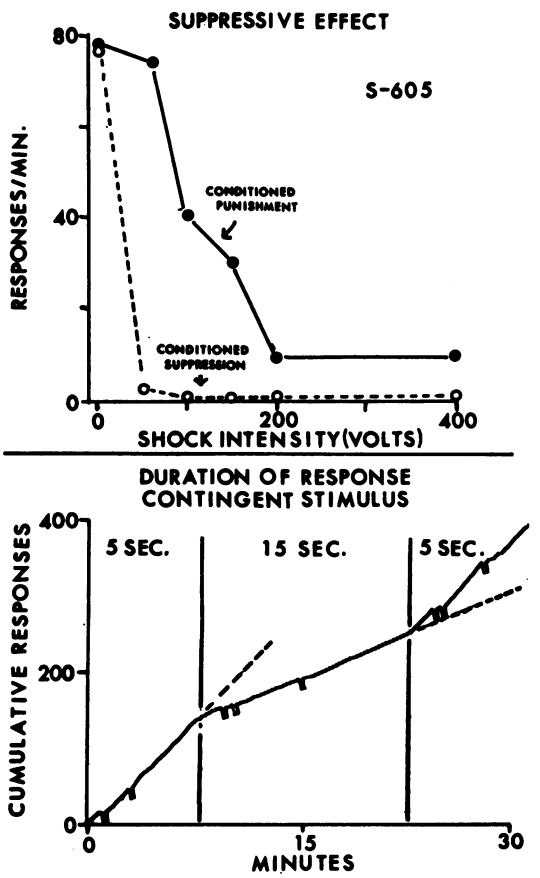

Fig. 7. Suppressive effects of the response-contingent stimulus. The top half shows the response rate during the response-contingent stimulus of the conditioned punishment procedure and the response rate during the prearranged stimulus of conditioned suppression. Each of the points represents the mean of the response rates attained during the last three sessions at a given shock intensity. The lower half illustrates the temporal spacing of responses as a function of the duration of the response-contingent stimulus. The prearranged stimulus-shock pairings occurred according to a 4-min VI and are indicated by the downward displacement of the response pen. The shock intensity was 200 v.

the fact that the response-contingent stimulus was not always followed by shock in the conditioned punishment procedure. In addition, it is possible that subjects responded during the 5-sec response-contingent stimulus as a result of a temporal discrimination that shock would not occur until the stimulus was present for a longer duration (15-sec). However, the investigation of Stein, Sidman, and Brady (1958) suggests an explanation simply in terms of the greater proportion of the session that the stimulus was present in the conditioned punishment procedure. Stein *et al.* (1958) found the most severe suppressive effects in conditioned suppression when the stimulus was present a small proportion of the session. During conditioned punishment the stimulus was present more than during conditioned suppression, since responses produced the stimulus in addition to the prearranged stimulus presentations.

The suppressive effect during conditioned punishment frequently produced a rather uniform temporal spacing of responses when the overall response rate was reduced to about 10-25 responses per minute. Usually, only a response or two occurred at the onset of the response-contingent stimulus. Shortly after its termination, the subject emitted another response, thereby producing the stimulus and repeating the process. Thus, the temporal spacing of responses was, to a large extent, determined by the duration of the response-contingent stimulus. The bottom half of Fig. 7 illustrates this rather precise control over the temporal spacing of responses. When the duration of the stimulus was 5 sec, the overall response rate was reduced to about 17 responses per minute. When the stimulus duration was changed to 15 sec, responding was immediately reduced to about seven responses per minute. Upon reinstating the 5-sec duration, responding approximated the level previously seen at that duration. Each change in the duration of the response-contingent stimulus resulted in an immediate change in the temporal spacing of responses. This temporal spacing of responses according to the duration of the response-contingent stimulus was observed in three of the four subjects. For subject 515, which did not show it, the overall response rate was abruptly reduced from a relatively high level to a very low level (Fig. 4). On the other hand, the relatively smooth response curves in Fig. 7 did not occur until responses were severely suppressed for the duration of the stimulus. At high overall response rates, considerable responding occurred during the stimulus; at very low overall response rates, responding was reduced immediately after the stimulus as well as during the stimulus.

The punishing effect of conditioned punishment is shown for all subjects as a function of shock intensity in Fig. 8. According to the definition provided above, the punishing effects of a response-contingent stimulus are measured in the absence of that stimulus. Hence, the

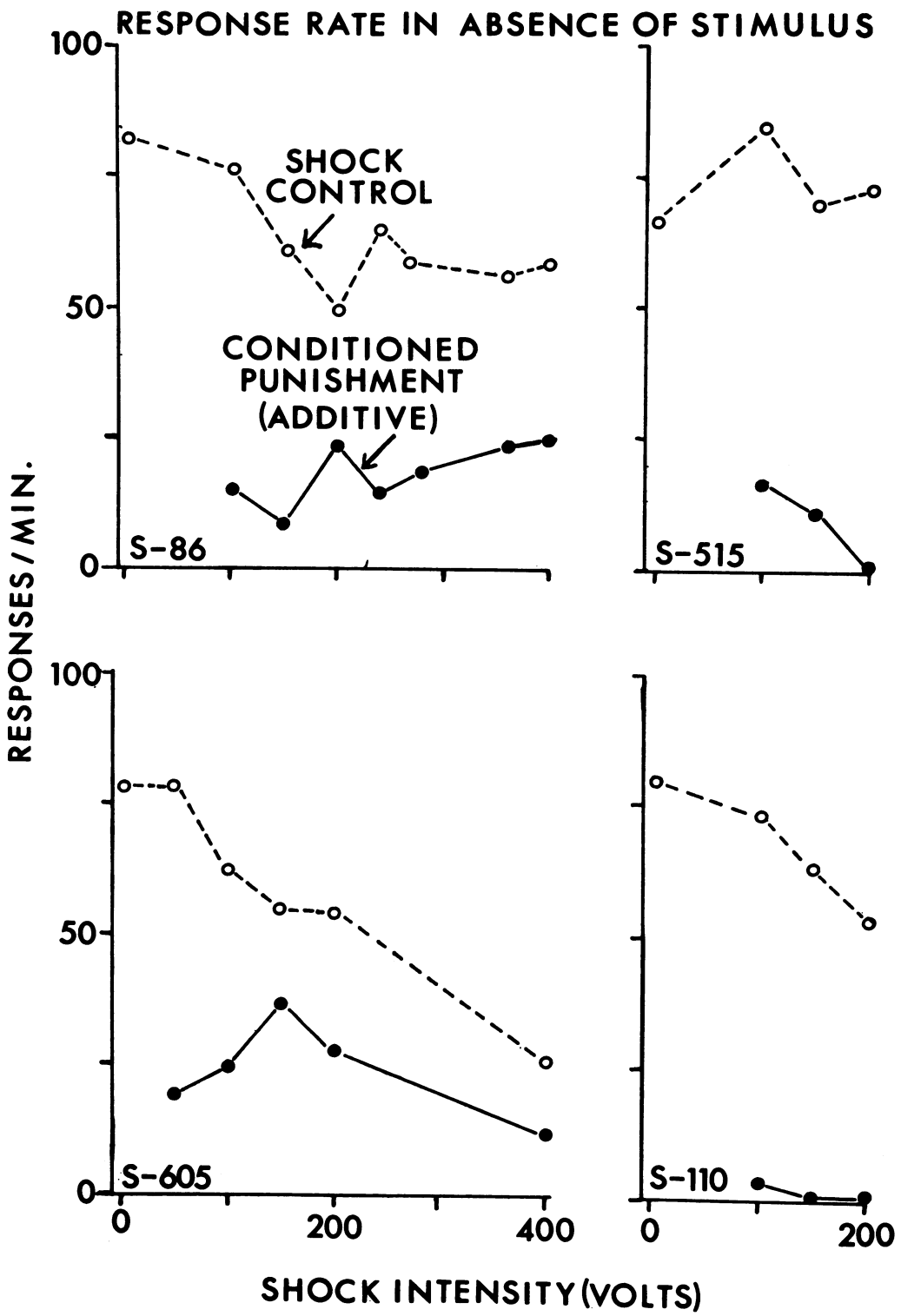

Fig. 8. Punishing effects of the response-contingent stimulus. The rates of response in the absence of the stimulus are presented as a function of shock intensity for conditioned punishment and shock control. Each of the points represents the mean of response rates attained during the last three sessions at a given shock intensity.

punishment effect must be measured from the punishing stimulus offset rather than from the preceding response. The rate of those responses which occurred in the absence of the stimulus is plotted in the conditioned punishment curves of Fig. 8. The curves for the shock control procedure show the response rate in the absence of the prearranged stimulus-shock presentations. The shock control procedure differed only in that responses in the absence of the stimulus did not produce the stimulus. In conditioned punishment, response rate in the absence of the stimulus was reduced to a low level at all shock intensities. As noted previously in Fig. 1, response rate was also reduced in shock control for three subjects. For all subjects, the rate of responses in conditioned punishment was usually reduced to less than half of the rate during shock control. The response rate during conditioned punishment was systematically related to shock intensity for two subjects.

In the present "additive" conditioned punishment procedure, each response in the presence of the response-contingent stimulus extended it 5-sec from the time of the response. This additive factor led to difficulties in interpreting the rate of response in the absence of the stimulus at 0 v and at some of the lower shock intensities. For example, at 0 v the high response rate during the response-contingent stimulus (Fig. 7) continually extended the stimulus. As a result, a reliable response rate could not be obtained for the brief periods (1 or 2 min per session) of time when the stimulus was absent. For this reason the response rate was not presented at 0 v in Fig. 8. Even at the lower shock intensities, the stimulus was frequently absent only during the period at the start of the session before the recovery in response rate (Fig. 5). Since it was not possible to evaluate the punishing effects of the stimulus throughout the session at the low shock intensities using the additive procedure, a second conditioned punishment procedure was introduced that eliminated this problem of indefinite extension of the stimulus.

EXPERIMENT II: "NON-ADDITIVE" CONDITIONED PUNISHMENT PROCEDURE

The present conditioned punishment procedure differed from the additive procedure only in that responses did not extend the response-contingent stimulus. Rather, the stimulus terminated after 5 sec regardless of the response rate in the presence of the stimulus. As a result, the stimulus was absent throughout much of each session, even at 0 v and the lower shock intensities.

This non-additive procedure was employed with subjects 110, 86, and 605 used in Exp I and one new subject (658). The procedures were the same as in Phases I and III of Exp I except that in the conditioned punishment procedure, responses during the response-contingent stimulus did not extend it. Subjects 110 and 658 were tested at four shock intensities and subjects 86 and 605 at one shock intensity. As in Exp I, both conditioned punishment and shock control (conditioned suppression) were studied at a given shock intensity before progressing to the next higher intensity. Subjects 110, 86, and 658 were started at 0 v and then tested at the shock intensities. The shock control procedure was run first at each intensity. Subject 605 was tested at 400 v at the conclusion of Exp I and then tested at 0 v.

Results and Discussion

The punishing effect of the response-contingent stimulus is illustrated as a function of shock intensity for all subjects in Fig. 9. Since the response-contingent stimulus was terminated after each 5-sec production, the stimulus was now absent long enough at 0 v (14-17 min per session) to allow a determination of the response rate in its absence. At 0 v the response rate during conditioned punishment was about equal to that during shock control, indicating that the stimulus *per se* had little or no effect upon the rate of responses producing it. However, after the stimulus-shock pairings, the rate of responses during conditioned punishment was reduced. For the subjects (110, 658) that were exposed to several shock intensities, the greatest reduction in the rate of responses producing the stimulus occurred at the higher shock intensities. The shock control procedure also reduced the response rate for those subjects (110, 658, 605) exposed to the higher shock intensities, but the reduction was considerably smaller than during conditioned punishment. The second point at 400 v in the conditioned punishment curve for subject 658 was obtained when the duration of

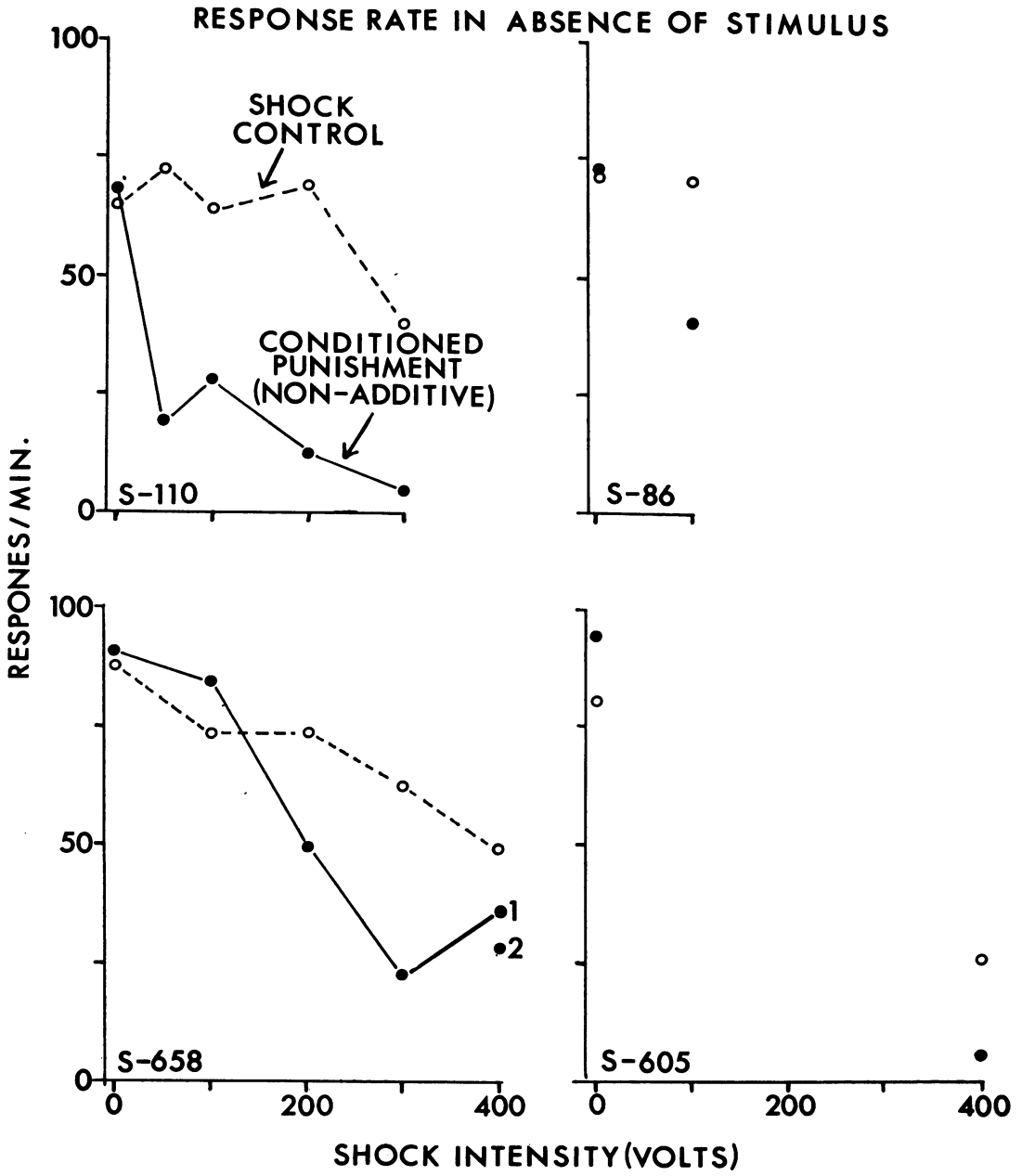

Fig. 9. Punishing effects of the response-contingent stimulus. The rates of response in the absence of the stimulus are presented as a function of shock intensity for the "non-additive" conditioned punishment procedure and the shock control procedure. Each of the points represents the mean of response rates attained during the last three sessions at a given intensity. The points for subjects 86 and 605 are not connected as only two points were obtained. The second point for subject 658 at 400 v in the conditioned punishment curve was obtained when the duration of the prearranged stimulus was changed to 5 sec.

the prearranged stimulus was changed from 15 sec to 5 sec. When the duration of the prearranged stimulus had been 15 sec at 400 v (point 1), this subject produced the 5-sec stimulus and continued to respond during the stimulus for a brief time, suggesting a discrimination that the shock did not occur shortly after the production of the stimulus but only after a longer stimulus duration had elapsed (15 sec).

The findings on the non-additive procedure indicate that (1) the response-contingent stimulus had little punishing effect before it was paired with shock, but (2) after the pairing with shock, the stimulus did have a punishing effect, and (3) the rate of responses producing the stimulus decreased as a function of shock intensity. Not all the reduction of responses in the absence of the stimulus can be attributed to effects of the shocks *per se, i.e.*, an inductive effect or to an unconditioned punishment effect resulting from an adventitious response-shock correlation (Azrin, 1956). These possibilities were excluded by the fact that conditioned punishment reduced responding more in the absence of the stimulus than did shock control, which had the same frequency of prearranged stimulus-shock pairings. The reduction which did occur in the absence of the stimulus during shock control indicates that the shocks *per se* did have some reductive effect, but not enough to account for all reduction in the conditioned punishment procedure. Rather, it appears that the response-contingent stimulus of the conditioned punishment procedure had a punishing effect upon responses.

GENERAL DISCUSSION

The present results indicate the possibility of testing a conditioned punishing stimulus while the properties of that stimulus are being maintained by continued pairings with shock. In previous experiments, conditioned punishers were tested only after the pairings of that stimulus and shock had been discontinued (Baron, 1959; Evans, 1962; Mowrer and Aiken, 1954; Mowrer and Solomon, 1954). Because of this discontinuation of the shock during testing, the latter procedure may be designated as an "extinction type". It appears then that there are two procedures for testing a conditioned punisher, the specific difference being whether or not the unconditioned stimulus is continued during the testing.

A similar procedural dichotomy exists in the areas of conditioned reinforcement and stimulus generalization which also involve testing the properties that a stimulus has acquired through association with an unconditioned stimulus. An extinction type procedure has been used traditionally in conditioned reinforcement by testing the properties of the conditioned reinforcer after discontinuing the unconditioned reinforcer (see reviews by Miller, 1951; Myers, 1958; Kelleher and Gollub, 1963). Traditional studies of stimulus generalization have also used this extinction type methodology by discontinuing the unconditioned stimulus (food in studies by Guttman and Kalish, 1956; and shock in the studies by Hovland, 1937) while testing for generalization effects. The apparent advantage of the extinction type procedure is that it allows evaluation of the acquired properties while excluding effects that might result from the presence of the unconditioned stimulus. However, this "pure" effect of extinction type procedures is achieved at the expense of precluding any long-term study of the acquired effects of the stimulus. The effects produced by the extinction procedure are necessarily transient because of the discontinuation of the unconditioned stimulus. As a result, many recent investigators in conditioned reinforcement and stimulus generalization have attempted to produce large and durable effects. For example, a recent review of the conditioned reinforcement literature (Kelleher and Gollub, 1963) indicates an increasing use of the chain schedule of Ferster and Skinner (1957) to test the effects of conditioned reinforcement. In the chain schedule, responses on one schedule produce a stimulus (conditioned reinforcer) in the presence of which additional responses produce the unconditioned reinforcer, food. Hence, the conditioned reinforcer is paired with the unconditioned reinforcer during testing. The sizable and enduring conditioned reinforcement effect produced by that procedure is well documented (Ferster and Skinner, 1957; Kelleher and Gollub, 1963). The present procedure for testing a conditioned punisher is comparable to the chain schedule in that the acquired properties of the stimulus are maintained by pairings with the unconditioned stimulus. Similarly, the continuation of an unconditioned stimulus (food in the study of Pierrel, 1958; and shock in the study of Honig and Slivka, 1964) during a discriminative stimulus has allowed investigators to study generalization gradients for longer periods than was possible in the extinction type procedure.

The most important advantage of continuing the unconditioned stimulus during testing appears to be the large and durable effect pro-

duced by that procedure. Although continuation of the unconditioned stimulus does allow potential confounding effects of the unconditioned stimulus, it should be pointed out that from a naturalistic point of view, the very impurity of this procedure may be its greatest asset. Phenomena such as generalization, conditioned reinforcement, and conditioned punishment would appear to have little relevance to the natural environment or the practical control of behavior if the effectiveness of these phenomena could not be maintained. Yet, casual observation of human behavior suggests that conditioned punishers and conditioned reinforcers such as warnings, threats, praise, smiles, *etc.*, do have large effects upon human behavior and their effectiveness frequently appears to be maintained for long periods of time. It may be inferred that the maintained effectiveness of these events in the natural environment results from occasional pairings with other unconditioned stimuli. The durability of the conditioned punisher in the present study appears to parallel the apparent durability of these events in the natural environment.

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